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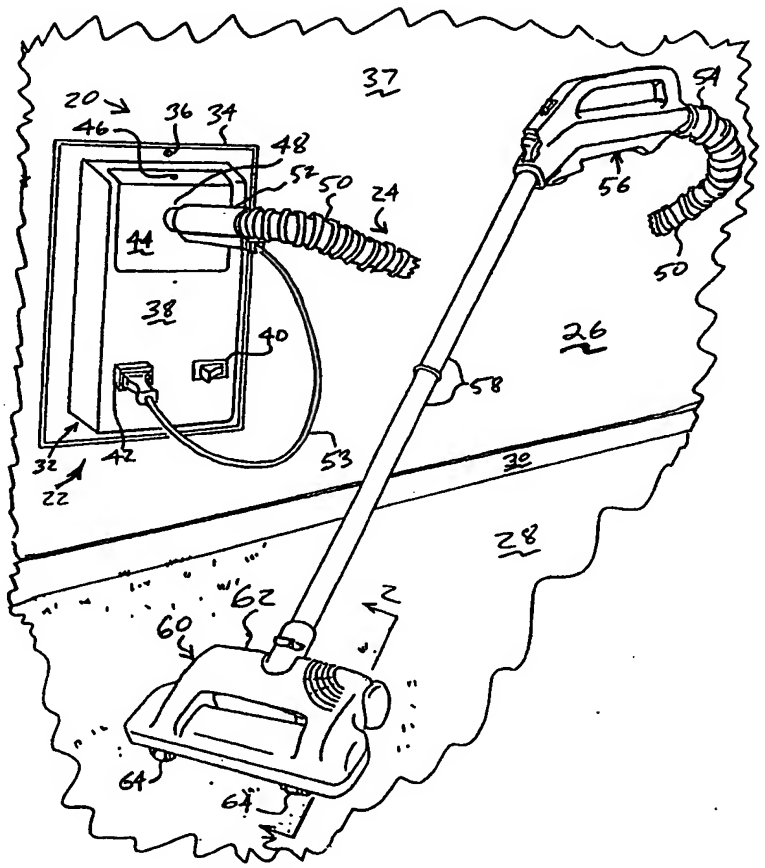
(54) Title: BUILT-IN VACUUM SYSTEM

(57) Abstract

A vacuum unit capable of being installed within a recess defined by a partition. The partition may be a wall or floor in a house. The partition includes an external member, such as a wallboard or a floorboard, and the external member includes an outer surface and an inner surface. The partition can further include supports, such as wall studs or floor joists, that corporate with the inner surface of the external member to define partition cavities, such as wall cavities or floor cavities. A partition opening, which is defined through the external member, is open to a partition cavity. A partition opening and the partition cavity that the partition opening is open to are together be referred to as a recess. The vacuum unit comprises a housing having a first section for insertion into a partition cavity through a partition opening. The housing further comprises a second section connected to the first section and for accessibly extending from the partition opening. The housing defines an internal housing chamber, and the second section of the housing defines an inlet to and outlet from the housing chamber. An air moving device forces air through the housing chamber in a direction defined from the inlet to the outlet to define a flow path and create a vacuum at the inlet. The flow path passes through a filter. The downstream hose end of a vacuum attachment is connected to the inlet of the housing chamber.



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BUILT-IN VACUUM SYSTEM

TECHNICAL FIELD

The present invention relates generally to vacuum cleaners, and in particular to vacuum systems having a vacuum unit that is installed to a portion of a house or other structure.

BACKGROUND OF THE INVENTION

Vacuum cleaners are commonly used to draw dirt and debris away from a surface being cleaned. A vacuum cleaner typically includes a housing or vacuum unit that contains an air moving device, such as a fan or a pump, that causes air to rush through the vacuum unit. A vacuum cleaner typically further includes a vacuum attachment, such as a hose, that is attached to the vacuum unit so that air rushing into the hose picks up dirt and carries it to a filter within the vacuum unit. The dirt is collected by the filter and filtered air is exhausted from the vacuum unit.

Use of vacuum cleaners is widespread. For example, vacuum cleaners are often used for removing dirt and dust from floor coverings, upholstery, tapestries, and various other household furnishings. To enhance the cleaning of household furnishings and the like, it is common for a vacuum attachment to include an agitator, such as a rotating brush. The agitator loosens dirt from the surface being cleaned in a manner that enhances the effectiveness of the vacuum cleaner.

It is common for a vacuum unit designed for household use to be equipped with wheels so that the vacuum unit can be rolled from room to room for use. To some

individuals, it is an inconvenience to have to move the vacuum unit from room to room, or up and down stairs.

Central vacuum cleaner systems solve the problem of having to more a vacuum unit from room to room, or up and down stairs. The vacuum unit of a central vacuum cleaner system is permanently installed. For example, in a house it is common to mount the vacuum unit of a central vacuum cleaner system in a closet or a basement. Numerous built-in tubular passages extend from the vacuum unit to normally closed, yet openable, receptacles arranged throughout the house. For a central vacuum cleaner system, the vacuum unit remains stationary and only the hose and other attachments, if desired, are moved from receptacle to receptacle. As the hose is moved from room to room for cleaning purposes, the hose is sequentially attached to the receptacles. While the hose is connected to a receptacle and the vacuum unit is operating, air and associated dirt or dust rush through the hose, through the built-in tubular passages associated with the receptacle being used, and then through the vacuum unit where the dirt is collected by a filter.

In addition to drawing air through a hose or other vacuum attachment, a vacuum unit of a central vacuum cleaner system must draw the air through the built-in tubular passages. Therefore, differential pressure losses, such as the loss caused by friction between the internal surfaces of passages and the air rushing therethrough, are typically greater in central vacuum cleaner systems than in vacuum cleaners having portable vacuum units. Accordingly, it is common for the vacuum unit of a central vacuum cleaner system to be larger than the vacuum unit of a traditional vacuum cleaner of the type that is rolled around a house. Thus, it is common for the vacuum unit of a central vacuum cleaner system to occupy a relatively large space, and thereby decrease the amount of usable space in the house or other structure within which it is installed.

Central vacuum cleaner systems are often installed during the construction of a home or other structure. Of course a central vacuum cleaner system can be installed after a house is completely constructed, but in some cases it can be difficult to install the built-in tubular passages after construction, especially where access to an attic, crawl space or basement is limited or nonexistent.

Thus, there is a need in the art for a vacuum cleaner that provides the convenience of a central vacuum cleaner system, yet does not substantially occupy usable space in a house or other structure and is easy to install, even after construction of the structure.

SUMMARY OF THE INVENTION

The invention seeks to provide an improved vacuum system that provides the convenience of a central vacuum cleaner system, yet does not substantially occupy usable space in a house or other structure and is easy to install, even after construction of the structure.

In accordance with the invention, these objectives are accomplished by providing a vacuum system having a vacuum unit capable of being installed at least partially within a recess defined by a partition. The partition may be a wall or floor in a house or other structure. In accordance with a first exemplary embodiment of the present invention the vacuum unit is constructed for installation at least partially within a recess defined by a wall. In accordance with a second exemplary embodiment of the present invention the vacuum unit is constructed for installation at least partially within a recess defined by a floor.

The partition preferably includes an external member, such as a wallboard when the partition is a wall or a floorboard when the partition is a floor, and the external member includes an outer surface and an inner surface. The partition can further include supports, such as wall studs when the partition is a wall or floor joists when the partition is a floor. The supports cooperate with the inner surface of the external member to define partition cavities, such as wall cavities when the partition is a wall or floor cavities when the partition is a floor. A partition opening, which is open to and provides access to a partition cavity, is defined through the external member. The partition opening and the partition cavity can together be referred to as a recess defined by the partition.

The vacuum unit is installed at least partially within a recess that preferably includes a partition opening that is open to a partition cavity. The vacuum unit includes a housing comprising a first section for insertion into the partition cavity through the partition opening. The housing of the vacuum unit further includes a second section connected to the first section for accessibly extending from the partition opening. The housing defines an internal housing chamber, and the second section of the housing defines an inlet to and outlet from the housing chamber. An air moving device, such as a fan or a pump, forces air through the housing chamber in a direction defined from the inlet to the outlet to define a flow path and create a vacuum at the inlet. The flow path passes through a filter.

The vacuum system further includes a conventional vacuum attachment. The downstream hose end of a conventional vacuum attachment is connected to the inlet of the housing chamber so that the vacuum can be used for cleaning purposes.

In accordance with another aspect of the invention, the vacuum unit includes a protrusion or flange that extends outwardly from the housing so that the first section of the housing can be moved into the recess until the movement is arrested by the protrusion interacting with the outer surface of the external member. The vacuum unit is installed by moving the vacuum unit into the recess until the flange abuts, either directly or indirectly, the external member to arrest movement of the vacuum unit. The flange engages the outer surface of the external member, either directly or indirectly, to positively identify when the vacuum unit is properly positioned in the recess. The flange, and thereby the vacuum unit, is secured to the partition by connecting the flange to the partition. Further, the flange covers any imperfections around the periphery of the recess.

In accordance with another aspect of the present invention, pattern sheets are provided that aid in the installation of the vacuum unit to a conventional wall or floor that defines a partition cavity but does not yet include a partition opening suitable for receiving the vacuum unit. The pattern sheet identifies where the partition opening should be defined through the external member of the wall or floor.

Other objects, features and advantages of the present invention will become apparent upon reviewing the following description of exemplary embodiments of the invention, when taken in conjunction with the drawings and the amended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a partially cut-away, pictorial view of a vacuum system in accordance with a first exemplary embodiment of the present invention.

Fig. 2 is a generally isolated, schematic, side cross-sectional view of a conventional power nozzle assembly of the vacuum system of Fig. 1, taken along line 2-2 of Fig. 1.

Fig. 3 is a pictorial, partially cut-away view of a vacuum unit of the vacuum system of Fig. 1.

Fig. 4 is a side view of the vacuum unit of the vacuum system of Fig. 1.

Fig. 5 is an isolated, schematic, side cross-sectional view of the vacuum unit of the vacuum system of Fig. 1, taken along line 5-5 of Fig. 3.

Fig. 6 is an isolated pictorial view of an acceptable conventional vacuum bag for use in the of the vacuum system of Fig. 1.

Figs. 7 and 8 are cut-away, pictorial views of the vacuum unit of the vacuum system of Fig. 1.

Fig. 9 is a pictorial view of the vacuum unit of the vacuum system of Fig. 1.

Fig. 10 is an isolated pictorial view of a secondary filter of the vacuum unit of the vacuum system of Fig. 1.

Fig. 11 is a pictorial view of a pattern sheet that has been attached to a wall, for aiding in the installation of the vacuum unit of the vacuum system of Fig. 1.

Fig. 12 is a pictorial view of a user installing a brace board of the vacuum system of Fig. 1.

Fig. 13 is a partially cut-away, pictorial view of a vacuum system in accordance with a second exemplary embodiment of the present invention.

Fig. 14 is an isolated, partially exploded, pictorial view of a vacuum unit of the vacuum system of Fig. 13.

Fig. 15 is a partially exploded, pictorial view of the vacuum unit of the vacuum system of Fig. 13.

Fig. 16 is a side view of the vacuum unit of the vacuum system of Fig. 13.

Figs. 17 and 18 are cut-away, pictorial views of the vacuum unit of the vacuum system of Fig. 13.

Fig. 19 is a pictorial view of a pattern sheet that has been attached to a floor, for aiding in the installation of the vacuum unit of the vacuum system of Fig. 13.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

Turning now to the drawings in which like numbers reference like parts in the several figures, Fig. 1 is a partially cut-away, pictorial view of a vacuum system 20 in accordance with a first exemplary embodiment of the present invention. As depicted in Fig. 1, the vacuum system 20 includes a vacuum unit 22, which is mounted to a partition member that is in the form of a wall 26, and a conventional vacuum attachment 24. The vacuum attachment 24 is the type that is typically used to clean a floor 28. The vacuum unit 22 creates a vacuum such that air flows into and through the vacuum attachment 24, and then into the vacuum unit 22. The air is filtered within and discharged from the vacuum unit 22. A baseboard 30 is depicted at the juncture between the wall 26 and floor 28, and portions of those components are cut-away in Fig. 1.

The wall 26 includes an outer surface 37 and defines a recess that extends into the wall 26 and is initially open at the outer surface 37, as will be discussed in greater detail below. The vacuum unit 22 includes a housing 32 that extends at least partially into the recess. The vacuum unit 22 further includes a protrusion that is preferably in the form

of a housing flange 34 that extends around and outwardly from the housing 32. The housing 32 of the vacuum unit 22 includes a front section 38 that extends from the front of the housing flange 34. The housing further includes a back section 84 (Figs. 3-5) that extends from the rear of the housing flange 34, and further extends into the recess defined by the wall 26.

As will be discussed in greater detail below, the vacuum unit 22 is installed by moving the vacuum unit 22 into the recess of the wall 26. The housing flange 34 aids in the installation of the vacuum unit 22. As the vacuum unit 22 is being moved into the recess of the wall 26, the back of the housing flange 34 abuts, either directly or indirectly, the outer surface 37 of the wall 26 to arrest movement of the vacuum unit 22. That is, the housing flange 34 engages the outer surface 37 of the wall 26, either directly or indirectly, to positively identify when the vacuum unit 22 is properly positioned in the recess defined by the wall 26. Further, the housing flange 34 covers any imperfections around the periphery of the recess defined by the wall 26. The housing flange 34, and thereby the vacuum unit 22, is secured to the wall 26 by a mounting screw 36, only the head of which is seen in Fig. 1.

The front section 38 of the housing 32 defines vent slots 39 (Figs. 3 and 4) that the vacuum unit 22 exhausts through. The front section 38 also includes a manually operated off / on switch 40, which controls operation of the vacuum unit 22, and an electrical receptacle 42. A dust cover 44, which is depicted in a closed configuration in Fig. 1, is pivotally or removably connected to the front section 38. In accordance with the first exemplary embodiment of the present invention, a cover hinge 110 (Fig. 4) pivotally connects the dust cover 44 to the front section 38 of the housing 32. The dust cover 44 is removably held to the front section 38 by a push button assembly 46. The dust cover 44 includes a hose receptacle 48 for receiving the end of the hose of a wide variety of conventional vacuum cleaner attachments.

As depicted in Fig. 1, the conventional vacuum attachment 24 is removably connected to the hose receptacle 48. The vacuum attachment 24 includes a flexible hose 50 having a downstream end 52 connected to the hose receptacle 48. The vacuum attachment 24 further includes an electrical conductor in the form of power cord 53 that extends from the downstream end 52 of the hose 50 and is plugged into the electrical receptacle 42. A middle portion of the hose 50 is cut-away in Fig. 1. An upstream end 54 of the hose 50 is connected to a handle 56 that defines a passage therethrough. The handle 56 is connected to a conventional power nozzle assembly 60 by tubes 58. The power nozzle assembly 60 includes a nozzle housing 62 from which rollers 64 extend. Each of the handle 56, the tubes 58 and the power nozzle assembly 50 function as extensions of the hose 50.

Fig. 2 is a generally isolated, schematic, side cross-sectional view of the conventional power nozzle assembly 60, taken along line 2-2 of Fig. 1. The nozzle housing 62 defines a nozzle chamber 68 that communicates with the ambient surroundings through a lateral slot 70. Referring also to Fig. 1, the nozzle chamber 68 communicates with the vacuum unit 22 by way of the tubes 58, handle 56 and hose 50. Therefore, when the vacuum unit 22 is operating and connected to the vacuum attachment 24 as depicted in Fig. 1, air is drawn into the nozzle chamber 68 through the lateral slot 70. A laterally extending agitating cylinder 72 extends proximate and parallel to the lateral slot 70. The agitating cylinder 72 is rotated, in a conventional manner, to agitate the surface of the floor 28 to loosen dirt and the like so that the dirt will be drawn through the nozzle chamber 68 and into the vacuum unit 22. Those skilled in the art will appreciate that the term dirt is used herein to refer to substances, including debris and dust, that are typically removed from a surface using a vacuum cleaner.

Bristles 74 extend from the agitating cylinder 72. The opposite ends of the agitating cylinder 72 are journaled so that the agitating cylinder 72 can rotate. A belt 78 extends from the output shaft of an electric motor 76 and cooperates with the agitating cylinder 72 to cause the agitating cylinder 72 to rotate. Referring also to Fig. 1, an intermediate power cord (not shown), which extends along or internally to the tubes 58, handle 56, and hose 50, electrically connects the power cord 80 that extends from the motor 76 to the power cord 53 that is removably plugged into the electrical receptacle 42.

Fig. 3 is a pictorial, partially cut-away view of the vacuum unit 22 exploded away from the wall 26. The hose receptacle 48 portion of the dust cover 44 at least partially bounds and defines a cover hole 82. The downstream end 52 (Fig. 1) of the flexible hose 50 (Fig. 1) of the vacuum attachment 24 (Fig. 1) is removably inserted into the cover hole 82 in Fig. 1. The back section 84 of the housing 32 of the vacuum unit 22 extends rearward from the housing flange 34. Attachment flanges 86 extend downward from the bottom of the back section 84 of the housing 32. An access plate 88 is depicted exploded away from an access opening (not shown, but see access opening 243 in Fig. 15 for example) that is defined through the rear panel of the back section 84. A pair of access screws 90 (also see Fig. 4) removably attach the access plate 88 to the back section 84.

As depicted in Fig. 3, the wall 26 includes a wallboard 98 such as, but not limited to, gypsum board or the like. A wall opening 100 is defined through the wallboard 98 to expose a wall cavity 102 that is rearward of the wallboard 98. The wall opening 100 and the wall cavity 102 can together be referred to as a recess that is defined by the wall 26. As depicted in Fig. 3, an electrical wire 92 that originates within the wall cavity 102 is connected to the vacuum unit 22. The electrical wire 92 is connected to the vacuum unit 22 just prior to the installation of the vacuum unit 22 to the wall 26. The electrical wire 92

extends through an aperture (not shown) defined through the bottom panel of the back section 84. The electrical wire 92 is secured to the back section 84 and that aperture is closed by a wire clamp assembly 94.

A gasket 96 of material such as, but not limited to, foam rubber is preferably attached to the rear surface of the housing flange 34. Each of the gasket 96 and the housing flange 34 preferably extend completely around the periphery of the housing 32. When the vacuum unit 22 is installed to the wall 26, a substantial portion of the back section 84 extends through the wall opening 100 and into the wall cavity 102. The gasket 96 contacts that portion of the outer surface 37 of the wall 26 that bounds the wall opening 100. While the gasket 96 is engaged to the outer surface 37, the mounting screw 36 is inserted through an aperture defined through the housing flange 34 and an annular spacer 106. Then the mounting screw 36 is screwed into a mounting hole 108 in the wallboard 98. The mounting screws 104 and attachment flanges 86 also facilitate the attachment of vacuum unit 22 to the wallboard 98.

Fig. 4 is a side view of the vacuum unit 22 mounted to the wall 26, wherein portions of the wall 26 are cut-away. A similar view of the side opposite from that depicted in Fig. 4 would generally be a mirror image of Fig. 4. As depicted in Fig. 4, the wall 26 further includes wall studs 112 extending rearward from an inner surface 113 of the wallboard 98. A brace support 114 is attached to the inner surface 113 of the wallboard 98 by the mounting screws 104 (Fig. 3) which extend through the wallboard 98 and into the brace support 114. The mounting screw 36 extends through the wallboard 98 and the brace board 114, which reinforces the wallboard 98. The attachment flanges 86 engage the inner surface 113 of the wallboard 98 to hold the bottom portion of the vacuum unit 22 in place.

Fig. 5 is an isolated, schematic, side cut-away view of the vacuum unit 22, taken along line 5-5 of Fig. 3. A side portion of the housing 32 is cut-away in Fig. 5. A similar side cut-away view of the side opposite from that depicted in Fig. 5 would generally be a mirror image of Fig. 5. A passage or housing chamber 116 that is defined within the housing 32 can be characterized as being segmented to define a venting subchamber 118 toward the bottom of the housing 32, a dust collection subchamber 134 toward the top of the housing 32, and a fan subchamber 125 that is between the venting subchamber 118 and the dust collection subchamber 134.

The venting subchamber 118 communicates through the vent slots 39 (Figs. 3 and 4). The venting subchamber 118 houses a circuit board / electrical controller 120. The electrical wire 92 is connected to the controller 120. This connection is facilitated during installation of the vacuum unit 22 by removing the access plate 88 to expose the access opening (not shown, but see access opening 243 in Fig. 15 for example) that

provides access to the venting subchamber 118. The controller 120 is connected by wires 122 to the off / on switch 40, electrical receptacle 42 and a motor 128. The controller 120 controls / provides power to those components in a conventional manner. A motor support 124 mounted within the housing chamber 116 defines the transition between the venting subchamber 118 and the fan subchamber 125.

A fan enclosure 126 occupies the fan subchamber 125, and is mounted upon the motor support 124. A portion of the fan enclosure 126 is cut-away in Fig. 5 to expose the fan subchamber 125. The fan enclosure 126 encloses the motor 128 and a fan 132 connected to the output shaft 130 of the motor 128. Those components are concealed from view in Fig. 5; therefore, they are depicted by broken lines. The fan enclosure 126 defines openings (not shown) through its top and bottom such that air flows through the fan enclosure 126 / fan subchamber 125 when the fan 132 is operated, as will be discussed in greater detail below. Those skilled in the art will appreciate that the motor 128 and fan 132 function as an air moving device, and that those components can be replaced with another conventional type of air moving device, such as a pump.

A secondary filter 138 removably resides within the dust collection subchamber 134, and is depicted as resting upon the top of the fan enclosure 126. A primary filter in the form of a conventional porous vacuum bag 136 also removably resides within the dust collection subchamber 134 above the secondary filter 138. Those skilled in the art will appreciate that different types of conventional filters can be incorporated into the vacuum unit 22. For example, filtering can be accomplished by bubbling air through water.

Fig. 6 is an isolated pictorial view of an acceptable conventional vacuum bag 136, in accordance with the first exemplary embodiment of the present invention. The vacuum bag 136 includes a bag portion 140 constructed of a porous material such as, but not limited to, cloth or paper. One end of the bag portion 140 is a closed end 142, and the opposite end is an open end 144. The periphery of the open end 144 is connected proximate to the periphery of a panel 146. The panel 146 defines a bag hole 148 that provides access to the inside of the bag portion 140. The bag hole 148 can be partially occluded by a movable flap.

Figs. 7 and 8 are cut-away, pictorial views of the vacuum unit 22. Lower portions of the vacuum unit 22 are cut-away, and portions of a user 150 (that is, the hands and arms of a user 150) are partially cut-away in Figs. 7 and 8. The dust cover 44 is in an opened configuration in Figs. 7 and 8. This open configuration is achieved by manipulating the push button assembly 46 and pivoting the dust cover 44 about the cover hinge 110. The dust cover 44 can be pivoted about the hinge 110 between the open configuration (Figs. 7 and 8) and the closed configuration (Figs. 1 and 3-5). The front

section 38 of the vacuum unit 22 defines a filter opening 152 (Fig. 9) that is open to the dust collection subchamber 134 (Fig. 5). The filter opening 152 is occluded by the panel 146 of the vacuum bag 136 when the vacuum bag 136 is in an installed configuration. The vacuum bag 136 is depicted in an installed configuration in Figs. 5 and 7.

As depicted in Fig. 8, he vacuum bag 136 can be withdrawn from the dust collection subchamber 134 through the filter opening 152 (Fig. 9). A vacuum bag 136 is installed in the dust collection subchamber 134 by gently pushing the bag through the filter opening 152, as depicted in Fig. 7. A lip that extends around the filter opening 152 cooperates with the periphery of the panel 146 so that a generally airtight seal is defined between the panel 146 and the front section 38. As depicted in Fig. 9, which is a pictorial view of the vacuum unit 22, subsequent to the removal of the vacuum bag 36 from the vacuum unit 22, the secondary filter 138 can be removed from the vacuum unit 22 through the filter opening 152. As depicted in Fig. 10, which is an isolated pictorial view of the secondary filter 138, the secondary filter 138 is dome shaped. The vacuum bag 136 is periodically removed from the vacuum unit 22 and replace with a new vacuum bag 136. The filter 138 is periodically removed from and the vacuum unit 22, cleaned, and reinstalled in the vacuum unit 22.

Referring back to Fig. 1, when the vacuum attachment 24 is connected to the vacuum unit 22 as depicted in Fig. 1, the downstream end 52 of the hose 50 protrudes through the cover hole 82 (Fig. 2) and the bag hole 148 (Fig. 6) of a vacuum bag 136 installed in the vacuum unit 22. Therefore, when the vacuum unit 22 is operating, the vacuum unit 22 creates a vacuum such that air flows through the vacuum attachment 24 and into the bag portion 140 of the vacuum bag 136. Referring to Fig., 5, those skilled in the art will understand that the vacuum is created by operation of the fan 132, which draws air through the housing chamber 116 and discharges the air out of the vent slots 39 (Figs. 3 and 4). Of course the air is drawn through the vacuum bag 136 and secondary filter 138 such that certain particles are removed from the air.

Fig. 11 is a partially cut-away, pictorial view of a pattern sheet 154 that has been attached to the outer surface 37 of a wall 26 by pieces of tape 156. The pattern sheet 154 aids in the installation of the vacuum unit 22 (Figs. 1 and 3-9). Portions of the wall 26 and a user 150 are cut-away in Fig. 11. The pattern sheet 154 depicts a rectangular opening pattern 160 which provides an indication of where the wallboard 98 should be cut to form the wall opening 100 (Figs. 3 and 12). The pattern sheet 154 further depicts arrows 162 that point toward locations where a punch 164 can be employed to make useful reference indentations in the wallboard 98, as should be understood by those skilled in the art in light of this disclosure. The pattern sheet 154 further depicts a rectangular brace

pattern 168 that provides an indication of the size of the brace board 114 (Fig. 4) and where it needs to be installed.

Wall studs 112 (also see Fig. 4) are hidden from view behind the wallboard 98 in Fig. 11, but are represented by broken lines. A horizontal cross section of each upright wall stud 112 may measure approximately two inches by four inches, and the wall studs 112 may be approximately sixteen inches apart, from center to center. As indicated by the placement of the pattern sheet 154, when installing the vacuum unit 22 in a wall 26 of the type including a wallboard 98 and wall studs 112 at spaced intervals, the wall opening 100 (Figs. 3 and 12) is preferably defined between wall studs 112, and the wall cavity 102 (Figs. 3 and 12) that the vacuum unit 22 is partially inserted into is preferably defined between a pair of neighboring wall studs 112 and the inner surface 113 (Fig. 4) of the wallboard 98. The rear of the wall cavity 102 may be closed by boards, or the like, extending between the rear edges of the wall studs 112.

Fig. 12 is a partially cut-away, pictorial view of a user installing the brace board 114 (Fig. 4) to the inner surface 113 (Fig. 4) of the wallboard 98 with the mounting screws 104. The wall 26 and user 15 are partially cut-away in Fig. 12. The brace board 114 is hidden from view in Fig 12, and is therefore depicted by broken lines.

Fig. 13 is a partially cut-away, pictorial view of a vacuum system 172 in accordance with a second exemplary embodiment of the present invention. As depicted in Fig. 13, the vacuum system 172 includes the conventional vacuum attachment 24 and a vacuum unit 174, which is mounted to a partition member that is in the form of the floor 28. The vacuum system 172 of the second exemplary embodiment is in some ways very similar or identical to the vacuum system 20 (Fig. 1) of the first exemplary embodiment. Therefore, unless indicated otherwise, components of the second exemplary embodiment that correspond to components of the first exemplary embodiment, as indicated by being similarly named or numbered, should be considered functionally similar.

The floor 28 includes an outer surface 180 (Fig. 16) that is not clearly seen in Fig. 13 because it is depicted as being covered by carpet. As discussed in greater detail below, the floor 28 defines a recess that extends into the floor 28 and is initially open at the outer surface 180. The vacuum unit 174 includes a housing 176 that extends at least partially into the recess defined by the floor 28. The housing 176 includes an upper section that is seen in Fig. 13 and a bottom section that extends into the recess defined by the floor 28 and is hidden from view in Fig. 13. The vacuum unit 174 further includes a protrusion that is preferably in the form of housing flange 178 that extends around and outwardly from the housing 176.

As will be discussed in greater detail below, the vacuum unit 174 is installed by moving the vacuum unit 174 into the recess defined by the floor 28. The housing flange

178 aids in the installation of the vacuum unit 174. As the vacuum unit 174 is being moved into the recess, the bottom of the housing flange 178 abuts, either directly or indirectly, the outer surface 180 (Fig. 16) of the floor 28 to arrest movement of the vacuum unit 174. That is, the housing flange 178 engages the outer surface 180 of the floor 28, either directly or indirectly, to positively identify when the vacuum unit 174 is properly positioned in the recess defined by the floor 28. Further, the housing flange 178 covers any imperfections around the periphery of the recess defined by the floor 28.

As mentioned, the housing 176 includes an upper section that is exposed in Fig. 13. Vent slots 184 are defined through the upper section. The upper section further includes an off / on switch 186 for controlling operation of the vacuum unit 174, and an electrical receptacle 188 for providing power to the vacuum attachment 24. A door or cover 190 is pivotally connected to the upper section of the housing 176. The cover 190 can pivot between an open configuration (depicted in Fig. 13) and a closed configuration (depicted in Figs. 15 and 16). In the open configuration the cover 190 conceals the portion of the vacuum unit 174 that includes the vent slots 184, the off / on switch 186 and the electrical receptacle 188, and in the closed configuration the cover does not conceal the portion of the vacuum unit that includes the vent slots, the off / on switch and the electrical receptacle. A dog 192 functions to releasably latch the cover 160 in its closed configuration. A dust cover 194 is also pivotally connected to the upper section of the housing 176. The dust cover can pivot between an open configuration (depicted in Fig. 14, 15, 17, and 18) and a closed configuration (depicted in Figs. 13 and 16). The dust cover 194 includes a hose receptacle 196 for receiving the downstream end 52 of the hose 50 of the vacuum attachment 24.

Fig. 14 is an isolated, partially exploded, pictorial view of the vacuum unit 174. The lower section of the housing 176 can be characterized as being that portion of the housing 176 that is below the housing flange 178. In contrast, the upper section of the housing 176 can be characterized as being that portion of the housing 176 that is at or above the housing flange 178. The housing 176 includes a dust collection subhousing 200 that removably receives a vacuum bag 136. The vacuum bag 136 is acceptably the conventional type described above. The dust cover 194 is pivotally connected to the dust collection subhousing 200 by a cover hinge 202. Mounting screws 204 are depicted exploded away from a plate of the cover hinge 202. A cover hole 206 is defined through the hose receptacle 196 portion of the dust cover 194. The housing 176 further includes a venting subhousing 208 to which the cover 160 is pivotally attached by a cover hinge 210. The housing 176 further includes an intermediate subhousing 212 to which an access plate 216 is attached by a pair of access screws 218. The housing 176 further includes a fan subhousing 220.

Fig. 15 is a pictorial, exploded, partially cut-away view of the vacuum unit 174 and the floor 28. As depicted in Fig. 15, the floor 28 is partially cut-away and includes a pair of floorboards 222. The upper floorboard 222 defines the outer surface 180 of the floor 28. A floor opening 224 is defined through the floorboards 222. The floor opening 224 is open to a floor cavity 226. The floor opening 224 and the floor cavity 226 can together be referred to as a recess that is defined by the floor 28. When the vacuum unit 174 is installed, the lower section 198 (Fig. 14) of the housing extends into the floor opening 224 and the floor cavity 226. The bottom side of the housing flange 178 engages that portion of the upper floorboard 222 that bounds the periphery of the floor opening 224.

As depicted in Fig. 15, the housing flange 178 bounds and defines an opening 228 that the dust collection subhousing 200 removably fits into. The dust collection subhousing 200 is exploded away from the housing flange 178, and the dust cover 194 is exploded away from the dust collection subhousing 200 in Fig. 3. A flange 230 extends from the upper periphery of the dust collection subhousing 200 and abuts the upper surface of the housing flange 178 when the dust collection subhousing 200 is installed in the opening 228. Pairs of apertures 232, 234, 236, which are defined through the plate of the hinge 202, the flange 230 of the dust collection subhousing 200, and the housing flange 178, respectively, align and receive mounting screws 204 which secure the vacuum unit 174 to the floor 28.

The dust collection subhousing 200 defines an internal dust collection subchamber 238 that houses the bag portion 140 (Fig. 6) of the vacuum bag 136. The dust collection subhousing 200 defines a flow path opening 240 that provides access to the dust collection subchamber 240. The dust collection subhousing 200 further defines a filter opening 241 (Fig. 18) that is open to the dust collection subchamber 240. The filter opening 241 is occluded by the panel 146 of the vacuum bag 136 when the vacuum bag 136 is in an installed configuration. The vacuum bag 136 is depicted in an installed configuration in Figs. 14 and 15.

The fan subhousing 220 defines an internal fan subchamber 242. A portion of the fan subhousing 220 is cut-away in Fig. 15 to expose the fan subchamber 242. The fan subchamber 242 communicates at one end with the dust collection subchamber 238 through the flow path opening 240. The fan subchamber 242 communicates at the opposite end with the intermediate subhousing 212 through a flow path opening 246, which is hidden from view in Fig. 15 and therefore depicted by broken lines. The intermediate subhousing 212 defines an internal intermediate subchamber 244 that communicates with the fan subchamber 242 through the flow path opening 246. The intermediate subhousing 212 defines an access opening 243 that is removably covered by the access plate 216. The

access plate 216 and access screws 218 are exploded away from the access opening 243 in Fig. 15. The venting subhousing 208 defines an internal venting subchamber 248. A portion of the venting subhousing 208 in Fig. 15 is cut-away to expose the venting subchamber 248. The venting subchamber 212 communicates with the ambient environment through the vent slots 184 (Figs. 13 and 14), and with the intermediate subchamber 244 through a flow path opening 250. The flow path opening 250 is hidden from view in Fig. 15 and is therefore depicted by broken lines. Since the dust collection subchamber 238, fan subchamber 242, intermediate subchamber 244, and venting subchamber 248 are connected, they each be considered to be a subpart of a larger housing chamber defined within the housing 176 of the vacuum unit 174.

The intermediate subhousing 212 further defines an opening (not shown) through which the electrical wire 245 that originates from within the floor cavity 226 is inserted and secured by a wire clamp assembly (not shown, but see wire clamp assembly 94 in Figs. 3-5 for example). The installer of the vacuum unit 174 can utilize the access opening 243 when attaching the electrical wire 245 to the vacuum unit 174, as should be understood by those skilled in the art.

Fig. 16 is a side view of the vacuum unit 174 mounted to the floor 28. Portions of the floor 28 are cut-away in Fig. 16. The hose 50 of the vacuum attachment 24 (Fig. 13) is depicted extended into the dust collection subhousing 200, and is partially cut-away. A similar view of the side opposite from that depicted in Fig. 16 would generally be a mirror image of Fig. 16. As depicted in Fig. 16, the wall 28 further includes floor joist 252 extending downward from an inner surface 253 of the lower floor board 222.

Select components hidden from view in Fig. 16 are depicted by broken lines. Referring also to Fig. 15, an end of the electrical wire 245 (Fig. 15) is connected to a circuit board / electrical controller 262 mounted within the intermediate subchamber 244 defined within intermediate subhousing 212. Wires (not shown, but see wires 122 in Fig. 5 for example) extend from the electrical controller 262 to the switch 186 (Figs. 13 and 14), the receptacle 188 (Figs. 13 and 14), and a motor 256. The motor 256 and a fan 260 mounted to the motor shaft 258 are within the fan subchamber 242 defined within the fan subhousing 220. Those skilled in the art will appreciate that the motor 256 and fan 260 function as an air moving device, and that those components can be replaced with another conventional type of air moving device, such as a pump. The bag portion 140 of the vacuum bag 136 (Fig. 6) and a secondary filter 254 are disposed within the dust collection subchamber 238 defined within dust collection subhousing 200.

Referring to Fig. 16, operation of the fan 260 causes air to flow through the passage defined through the vacuum unit 174 in the direction indicated by arrows. The flow path is defined through the bag portion 140 of the vacuum bag 136, then through the

secondary filter 254, then through the fan subhousing 220, then through the intermediate subhousing 212, and then through the venting subhousing 208 and out the vent slots 184 (Figs. 13 and 14). The flow is filtered and creates a usable vacuum at the hose receptacle 196 (Fig. 13).

Figs. 17 and 18 are cut-away, pictorial views of the vacuum unit 22 showing a user 150 removing the vacuum bag 136 and secondary filter 254, respectively, from the filter opening 241 (Fig. 18). Lower portions of the vacuum unit 174 are cut-away, and portions of a user 150 (that is, the hands and arms of a user 150) are partially cut-away in Figs. 17 and 18.

Fig. 19 is a partially cut-away, pictorial view of a pattern sheet 264 that has been attached to the outer surface 180 of a floor 28 by pieces of tape 156. The pattern sheet aids in the installation of the vacuum unit 174 (Figs. 13-18). Portions of the floor 28 and a user 150 are cut-away in Fig. 19. The pattern sheet 264 depicts a rectangular opening pattern 270 which provides an indication of where the floorboards 222 should be cut to form the floor opening 224 (Fig. 15). The pattern sheet 264 further depicts arrows 162 that point toward locations where a punch 164 can be employed to make useful reference indentations in the upper floorboard 222, as should be understood by those skilled in the art in light of this disclosure.

Floor joists 252 (also see Fig. 16) are hidden from view behind the floorboards 222 in Fig. 19, but are represented by broken lines. A vertical cross section of each horizontal floor joist 252 may measure approximately two inches by eight inches, and the floor joists may be approximately sixteen inches apart, from center to center. As indicated by the placement of the pattern sheet 264, when installing the vacuum unit 174 in a floor 28 of the type including floorboards 222 and floor joists 252 at spaced intervals, the floor opening 224 (Fig. 15) is preferably defined between floor joists 252, and the floor cavity 226 (Fig. 15) that the vacuum unit 174 is partially inserted into is preferably defined between a pair of neighboring floor joists 252 and the inner surface 253 (Fig. 16) of the bottom floorboard 222. The rear of the floor cavity 226 may be closed by boards, or the like, extending between the lower edges of the floor joists 252.

Those skilled in the art will appreciate that the vacuum unit 174 (Figs. 13-18) is mounted more flush with respect to the floor 28 (Figs. 13, 15-16 and 19) than the vacuum unit 22 (Figs. 1, 3-5, and 7-9) is mounted with respect to the wall 26 (Figs. 1, 3-4 and 11). However, in accordance with an alternative embodiment of the present invention a flush mounted alternative vacuum unit is provided that is constructed, used, and installed identically to the vacuum unit 22, except for variations noted and variations that will be apparent to those skilled in the art.

Referring to Fig. 4, the alternative vacuum unit is preferably constructed so that it protrudes only approximately 0.25 inches from the outer surface 37 of the wall 26 to which it is installed. In order for the alternative vacuum unit to be mounted approximately flush with the outer surface 37, the vent slots 39 are defined through the front section 38, the housing flange 34, the gasket 96 and the push button 46 are more proximate to the front section 38, and the upper portion of the dust cover 44 extends only slightly rearward of the front section 38. Alternatively the dust cover of the alternative vacuum unit may resemble the dust cover 194 illustrated in Figs. 13-18.

After the alternative vacuum unit is mounted to a wall 26 in a manner similar to that illustrated in Fig. 1, trim may be installed to the outer surface 37 of the wall to closely bound or overlap the housing flange 34. That is, a first trim board may be installed parallel and proximate to the upper edge of the housing flange 34, a second trim board may be installed parallel and proximate to the right edge of the housing flange, a third trim board may be installed parallel and proximate to the left edge of the housing flange, and a fourth trim board may be installed parallel and proximate to the lower edge of the housing flange. A cover or door may be mounted by hinges to one of the trim boards. Preferably the door is mounted to the trim board at the right or left edge of the housing flange 34 so that the door pivots about a vertical axis. Once installed, the door or cover may be pivoted between a first configuration in which the cover completely conceals the alternative vacuum unit, and a second configuration in which the cover does not conceal the alternative vacuum unit. Those skilled in the art will appreciate that the alternative vacuum unit, along with its associated trim and door, may be installed to a floor 28 (Figs. 13, 15-16 and 19) rather than a wall 26 (Figs. 1, 3-4 and 11).

While the present invention in its various aspects has been described in detail with regard to exemplary embodiments thereof, it should be understood that variations, modifications and enhancements can be made to the disclosed apparatus and procedures without departing from the spirit and scope of the present invention.

CLAIMS

What is claimed is:

1. A vacuum cleaner for cleaning dirt from a surface and capable of being installed to a member having an outer surface and defining a recess that is open at the outer surface, the vacuum cleaner comprising:

a housing capable of being at least partially inserted into the recess and defining a passage;

a protrusion extending outwardly from said housing so that said housing can be moved into the recess until the movement is arrested by said protrusion interacting with the member that defines the recess;

an air moving device mounted to said housing and operable for moving air through said passage to define a flow path; and

a filter within said passage for collecting dirt carried along said flow path.

2. The vacuum cleaner of Claim 1, wherein said protrusion comprises a flange that at least partially bounds said housing.

3. The vacuum cleaner of Claim 2, wherein said flange defines an aperture for receiving an elongate attachment device for securing said flange, and thereby said housing, to said member.

4. The vacuum cleaner of Claim 1, further comprising a hose having an upstream end and a downstream end, wherein said downstream end is operable for being connected to said passage so that air rushes into said upstream end of said hose, through said hose, and then along said flow path so that dirt can be drawn into said upstream end of said hose and then be collected by said filter while said air moving device being operated.

5. The vacuum cleaner of Claim 4, further comprising:

a rotatable brush proximate to said upstream end of said hose; and

an electric motor operable for rotating said brush in a manner that causes said brush to agitate the surface being cleaned in a manner that promotes the picking up of dirt by air moving into said upstream end of said hose.

6. The vacuum cleaner of Claim 5, wherein:

said housing comprises an off / on switch for controlling operation of said air moving device and an electrical receptacle; and

the vacuum cleaner further comprises an elongate electrical conductor extending from said electric motor for electrically connecting to said electrical receptacle.

7. The vacuum cleaner of Claim 1, wherein

the vacuum cleaner further comprises a cover movably connected to said housing for defining a closed configuration in which said cover at least partially covers an inlet to said passage and an open configuration in which said cover is at least partially moved away from said inlet to said passage, said cover defining an aperture therethrough for removably receiving and placing an end of a hose in communication with said passage; and

wherein said filter comprises a porous bag disposed within said housing and removable through said inlet to said passage when said cover is in said open configuration.

8. The vacuum cleaner of Claim 7, further comprising a secondary filter, wherein air flowing along said flow path flows through said secondary filter after flowing through said porous bag and before flowing past said air moving device.

9. In combination:

a member having an outer surface and an inner surface;

supports cooperating with said inner surface of said member to define a cavity between said inner surface and said supports, said member defining an opening to said cavity; and

a vacuum cleaner that is capable of cleaning dirt from a surface, said vacuum cleaner comprising:

a housing at least partially within said cavity and defining a passage;

a hose comprising an upstream end and a downstream end connected to and communicating with said passage;

an air moving device operable for moving air into said upstream end of said hose and along a flow path defined through said hose and then through said passage; and

a filter within said passage and through which said flow path extends, said filter being operable for collecting dirt picked up by the air moving into said upstream end of said hose.

10. The combination of Claim 9, wherein:

said member comprises a wallboard; and

said supports comprise wall studs.

11. The combination of Claim 9, wherein:

said member comprises a floorboard; and

said supports comprise floor joists.

12. The combination of Claim 9, further comprising a flange extending outwardly from said housing and mounted to said outer surface of said member.

13. The combination of Claim 9, further comprising:

a rotatable brush proximate to said upstream end of said hose; and

an electric motor operable for rotating said brush in a manner that causes said brush to agitate a surface being cleaned in a manner that promotes the picking up of dirt from the surface by air moving into said upstream end of said hose.

14. The vacuum cleaner of Claim 9, wherein:

the vacuum cleaner further comprises a cover movably connected to said housing for defining a closed configuration in which said cover at least partially covers an inlet to said passage and an open configuration in which said cover is at least partially moved away from said inlet to said passage, said cover defining an aperture therethrough for removably receiving and placing an end of a hose in communication with said passage; and

wherein said filter comprises a porous bag disposed within said housing and removable through said inlet to said passage when said cover is in said open configuration.

15. The combination of Claim 9, further comprising a cover operative for pivoting between a first configuration in which said cover at least partially conceals at least a portion of said housing and a second configuration in which said portion of said housing is not concealed by said cover.

16. A method of installing a vacuum cleaner that is capable of cleaning dirt from a surface, comprising the steps of:

moving a vacuum unit at least partially into an opening defined by a member; and

mounting the vacuum unit to the member so that the vacuum unit is at least partially within the opening.

17. The method of Claim 16, further comprising the steps of:

attaching a hose to the vacuum unit;

operating the vacuum unit so that air rushes into an end of the hose and then through the vacuum unit where the air is filtered; and

moving the end of the hose across a surface so that dirt on the surface is picked up by the moving air and is collected by the filter.

18. The method of Claim 16, wherein the moving step comprises the step of moving the vacuum unit into the opening until the moving is arrested by a protrusion extending outwardly from the vacuum unit cooperating with the member that defines the opening.

19. The method of Claim 16, further comprising the step of cutting the member to define the opening so that the opening is open to a cavity defined between an inner surface of the member and supports cooperating with the inner surface of the member, and wherein the moving step comprises the step of moving the vacuum unit at least partially into the cavity.

20. The method of Claim 19, wherein the moving step comprises the step of moving the vacuum unit into the cavity via the opening until the moving is arrested by a protrusion extending outwardly from the vacuum unit cooperating with an outer surface of the member.

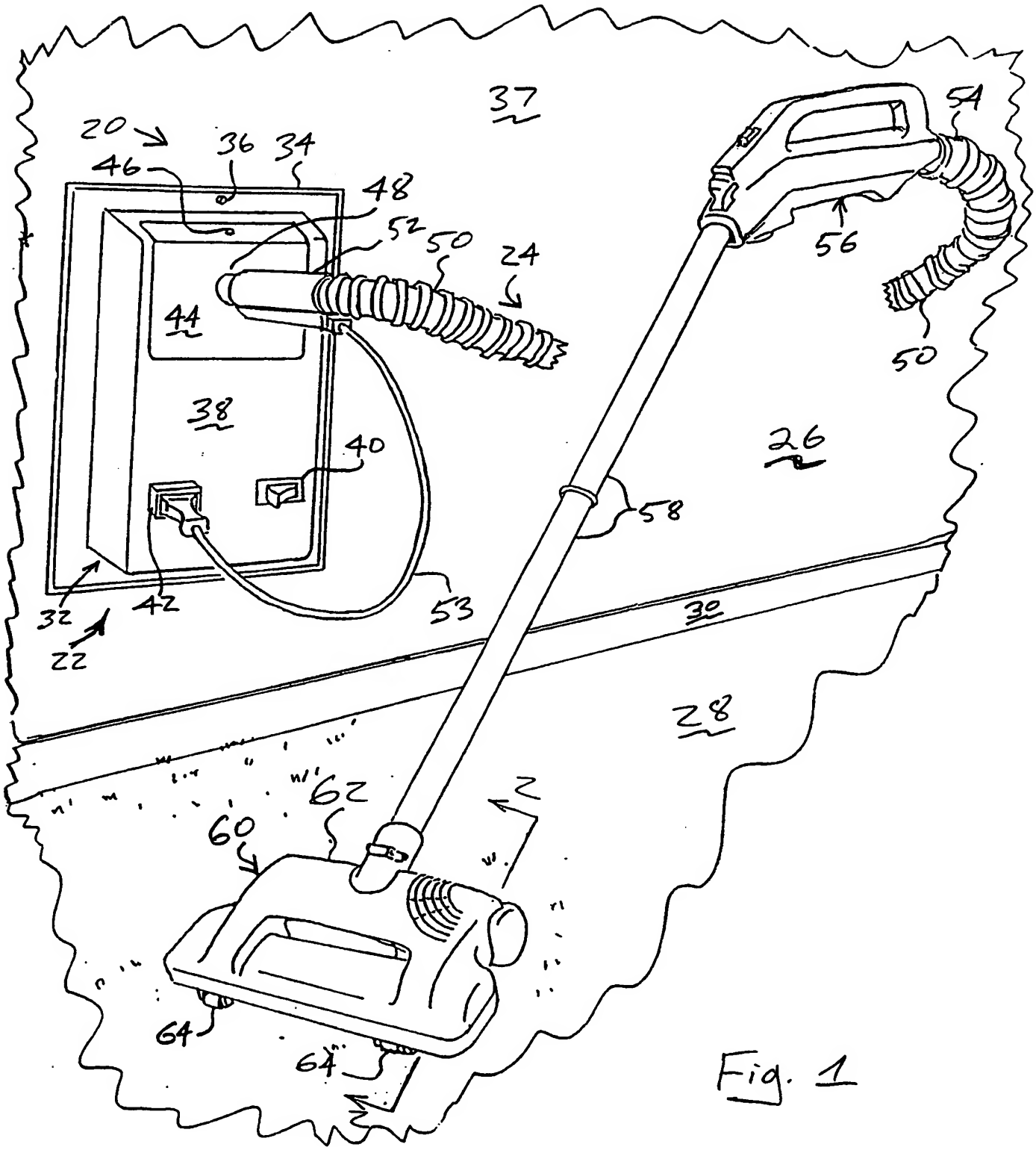
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Fig. 1

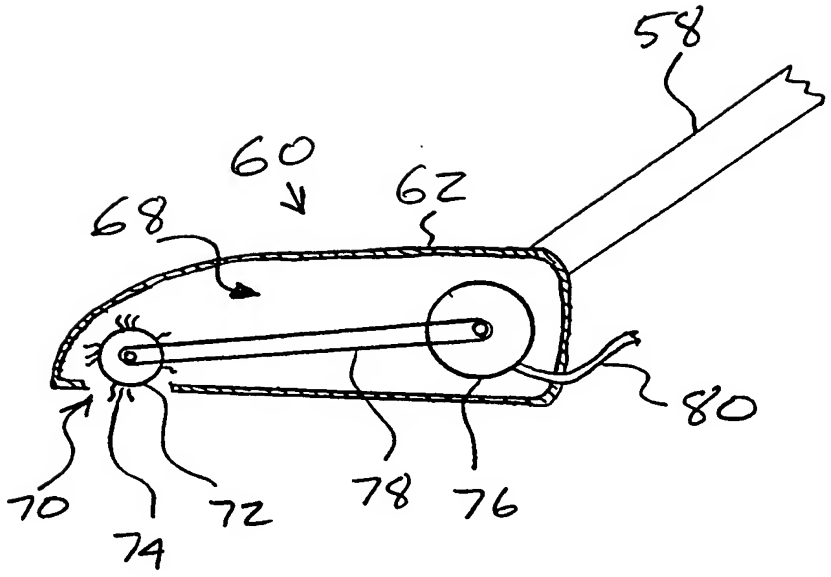

Fig. 2

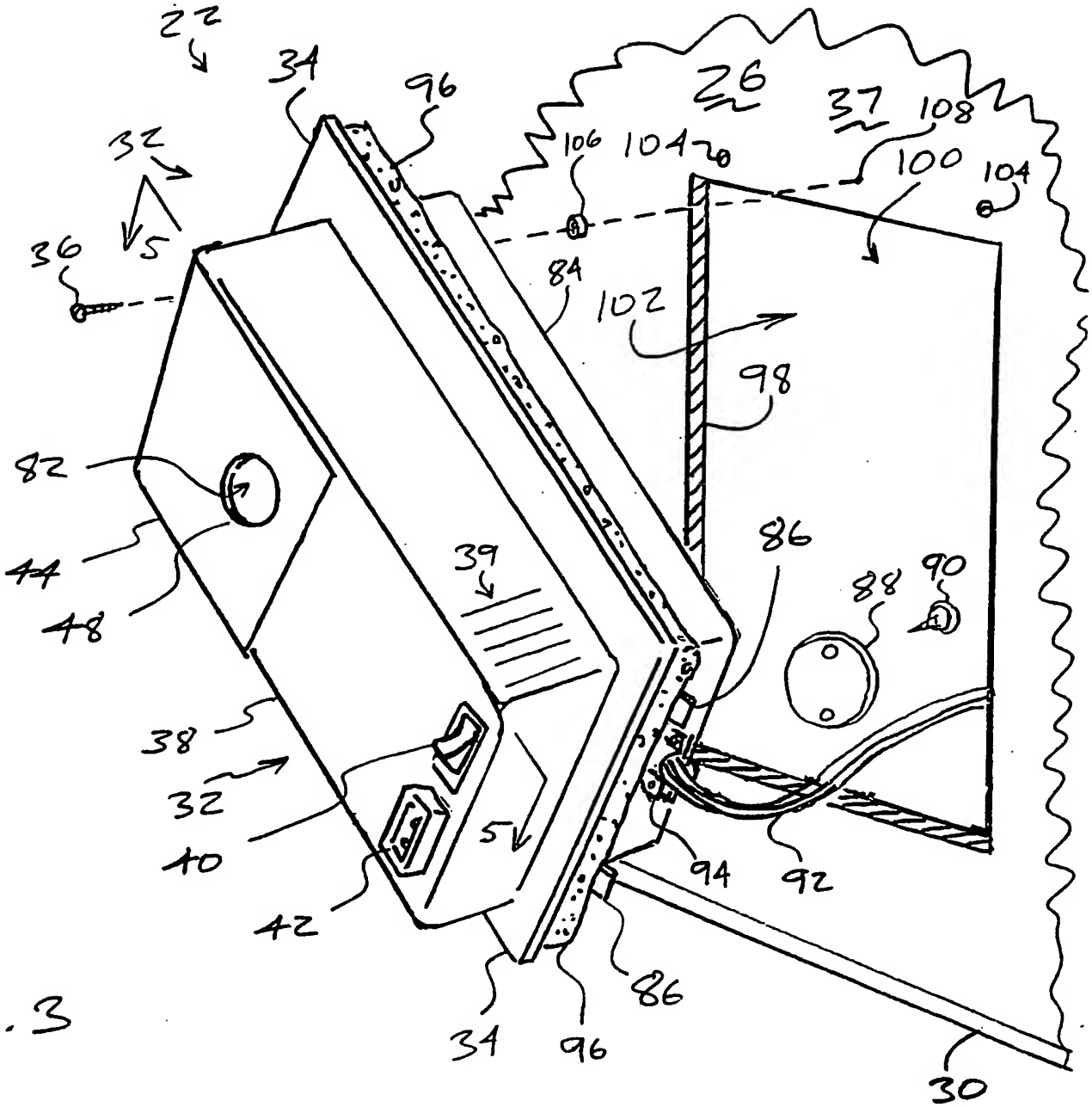
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Fig. 3

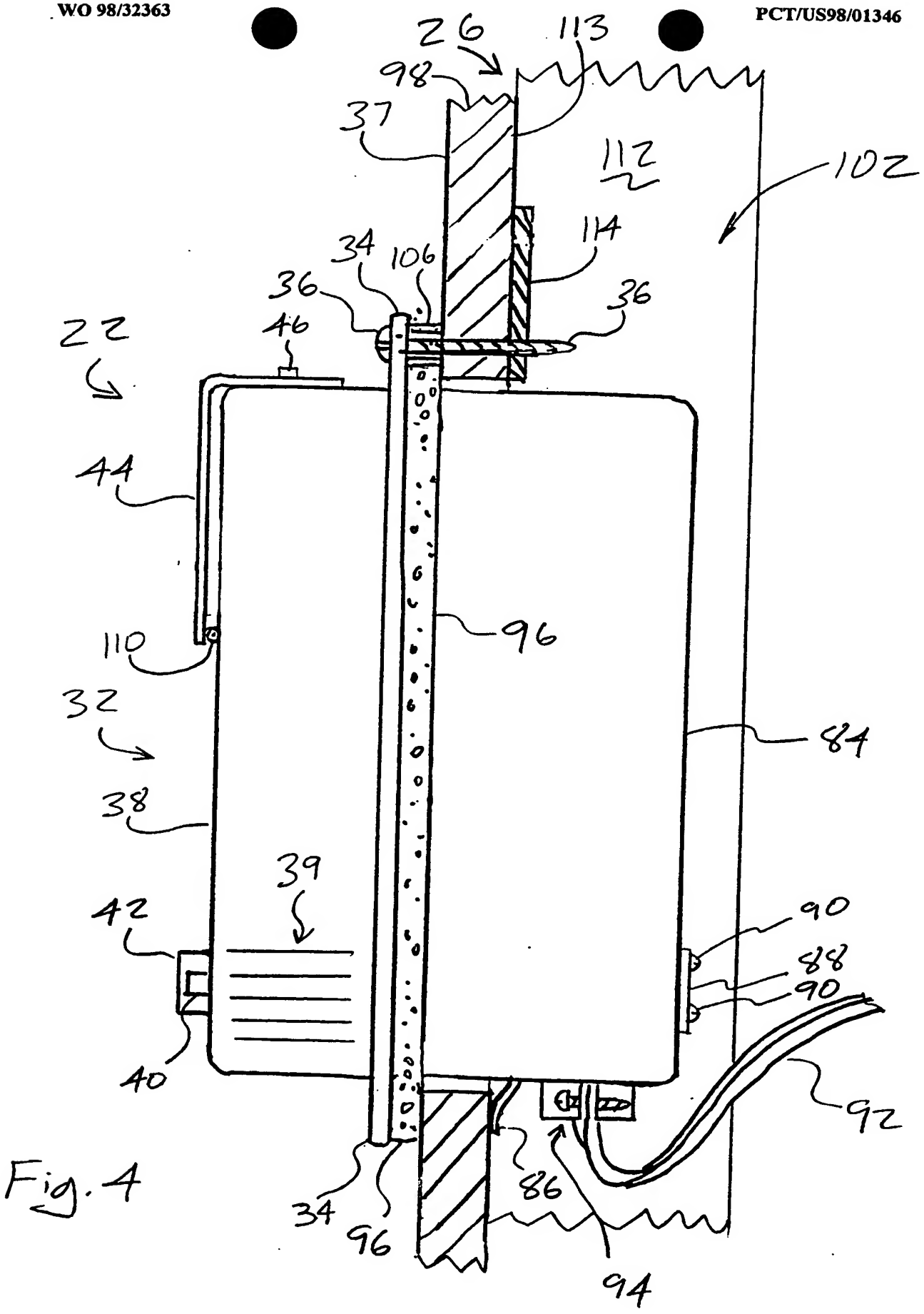
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Fig. 4

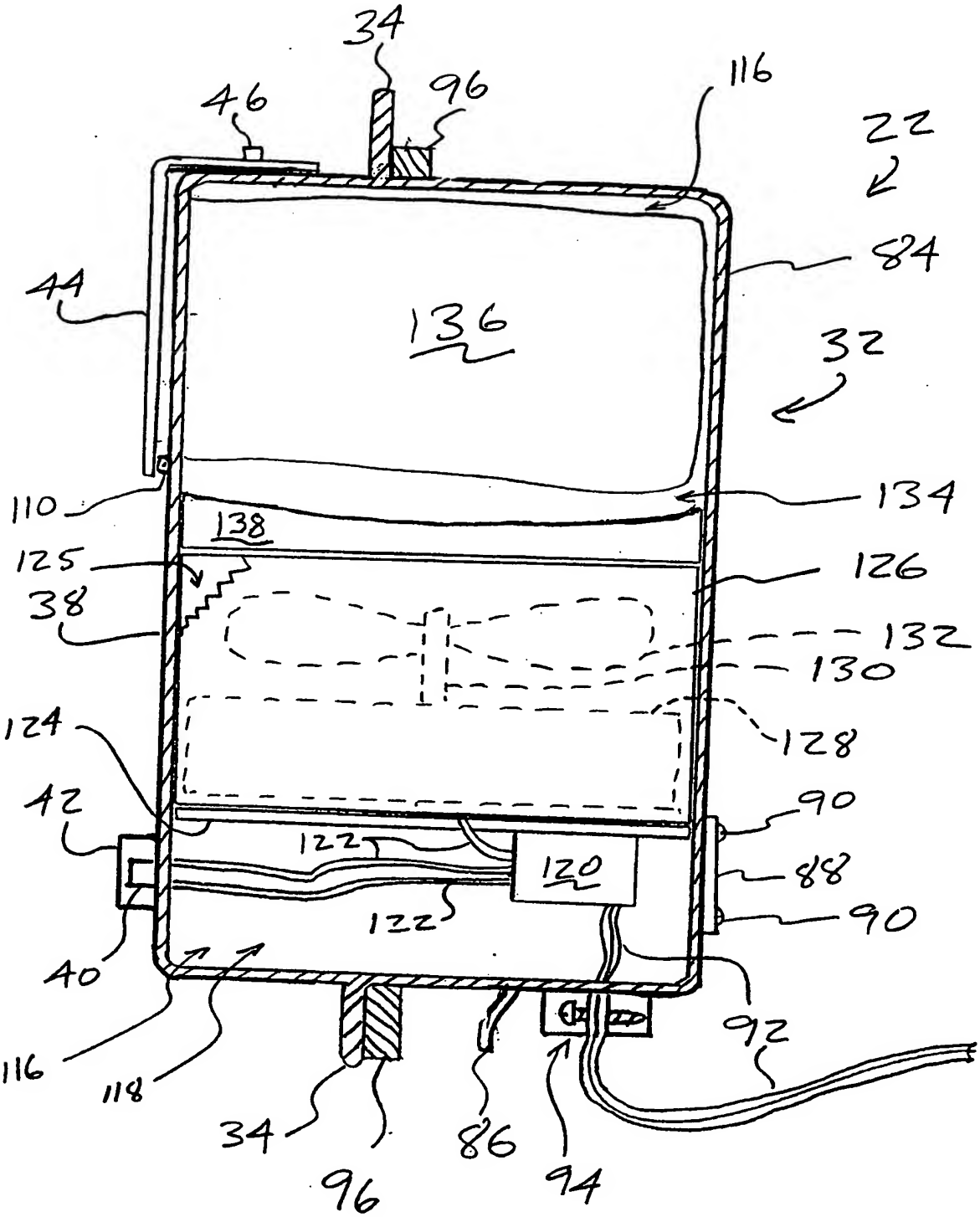
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Fig. 5

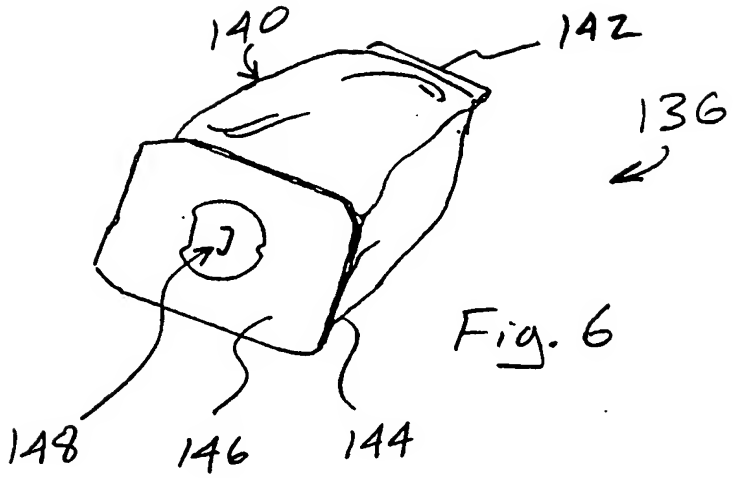

Fig. 6

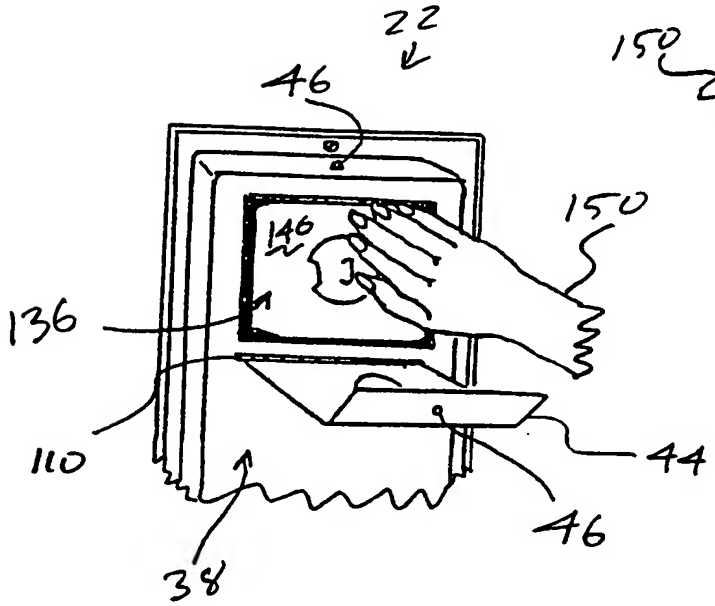

Fig. 7

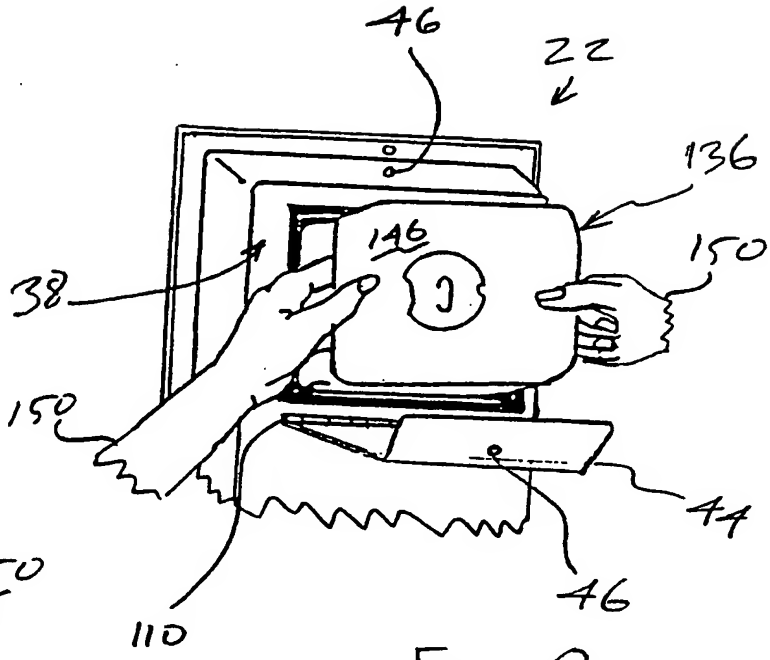

Fig. 8

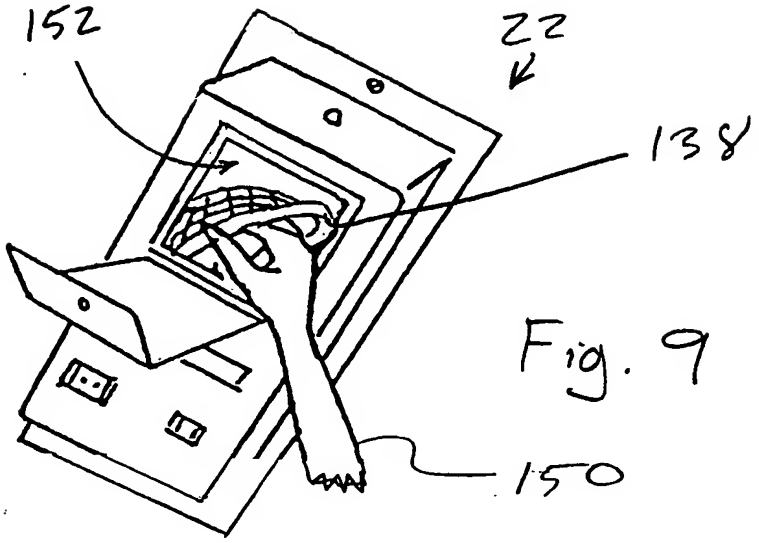

Fig. 9

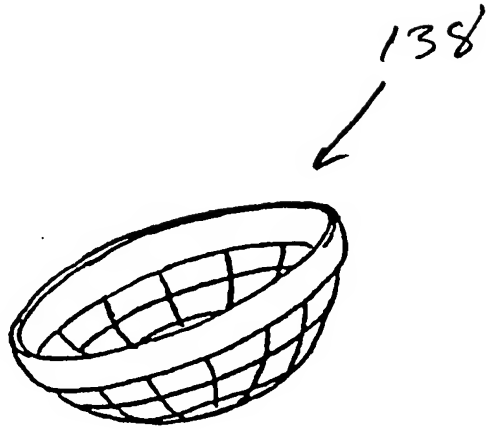

Fig. 10

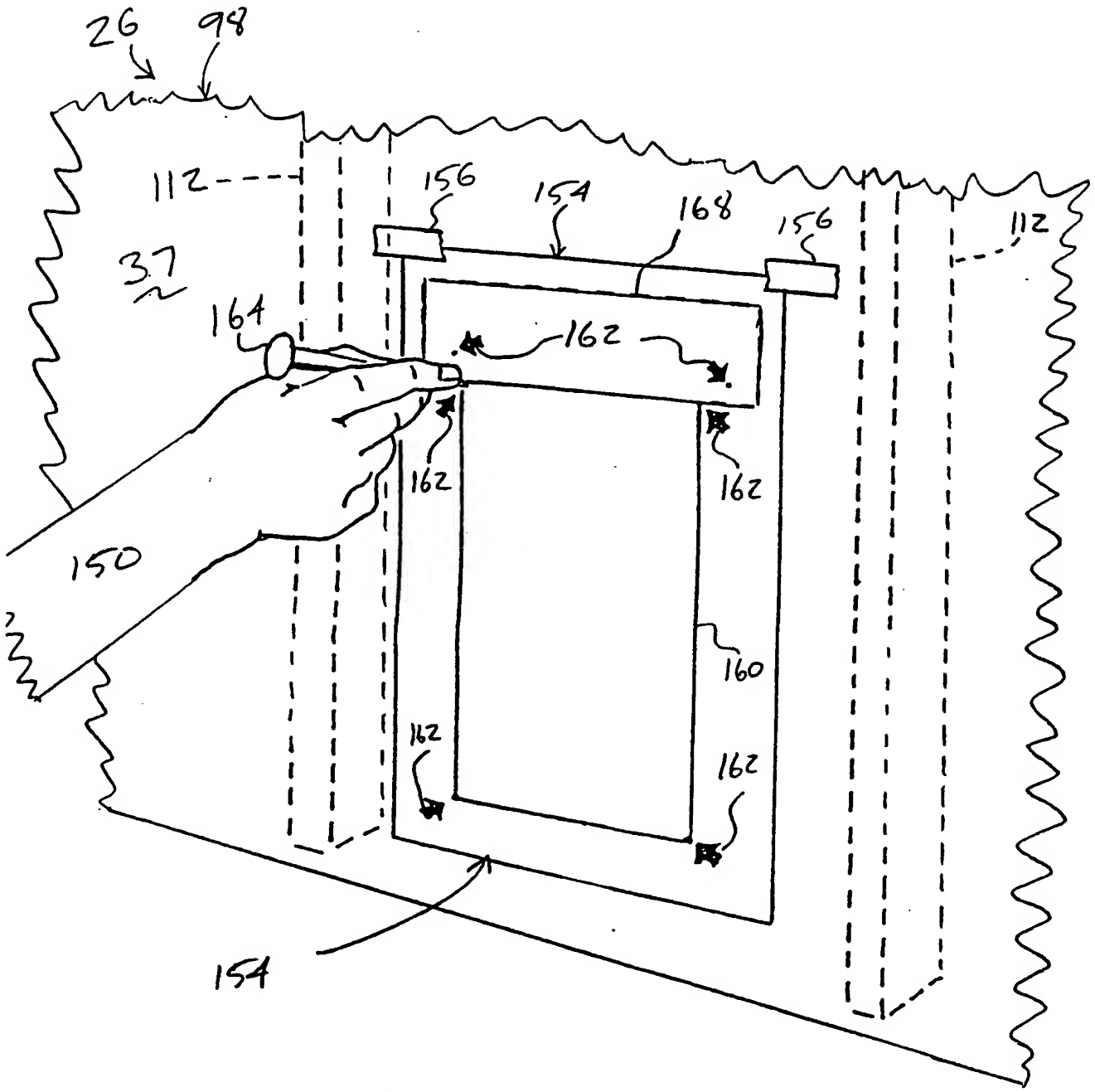
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Fig. 11

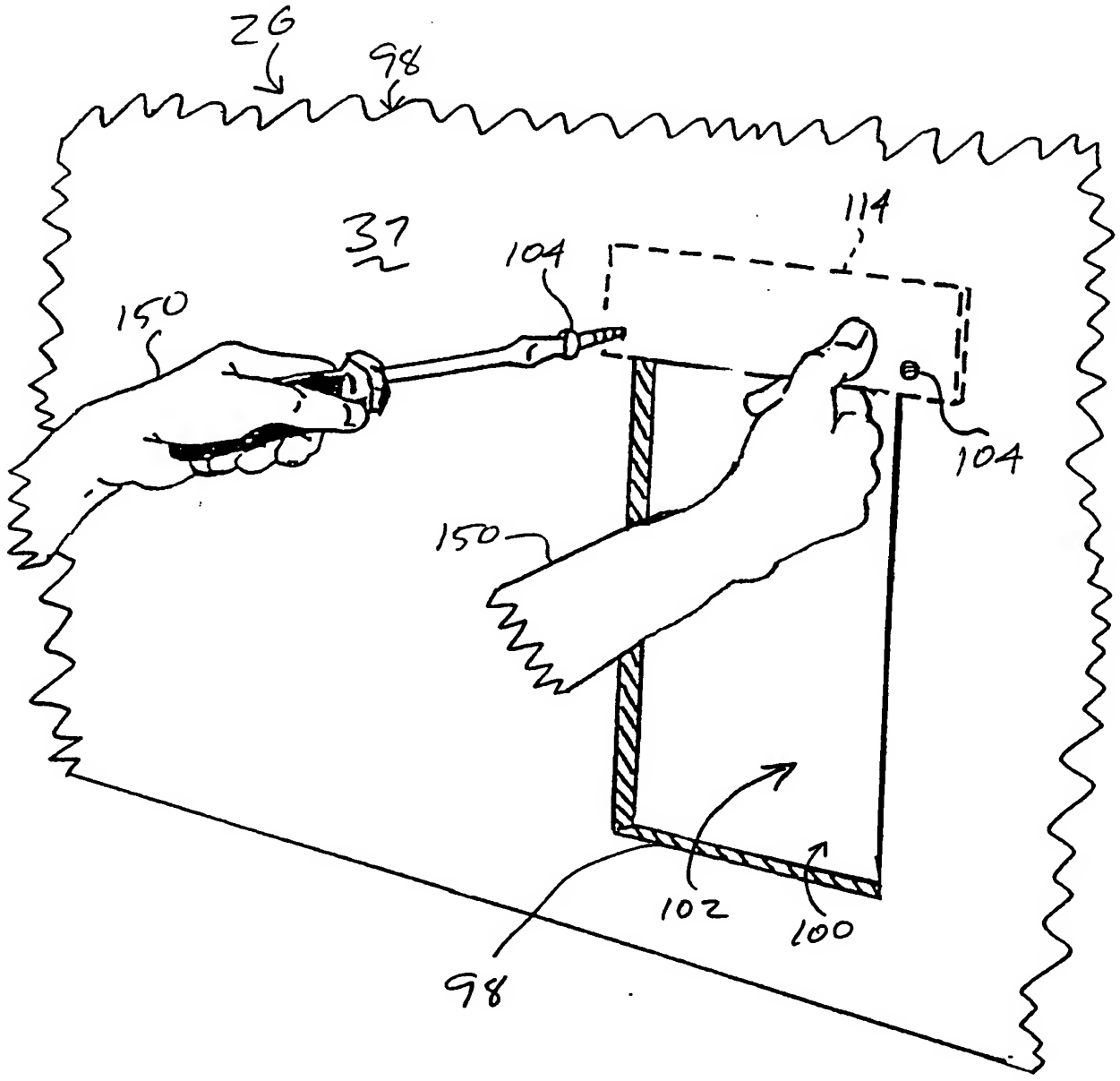

Fig. 12

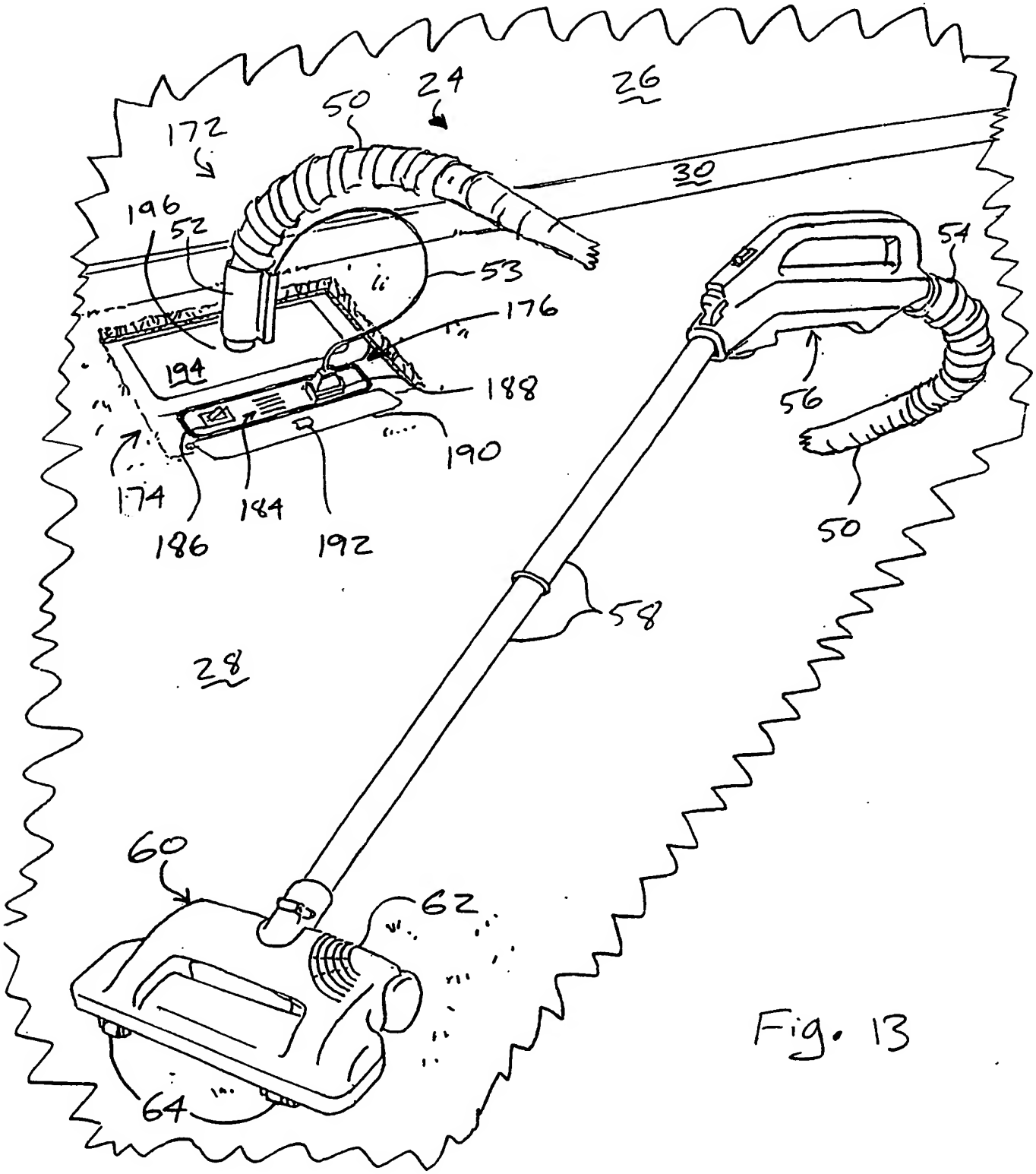
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Fig. 13

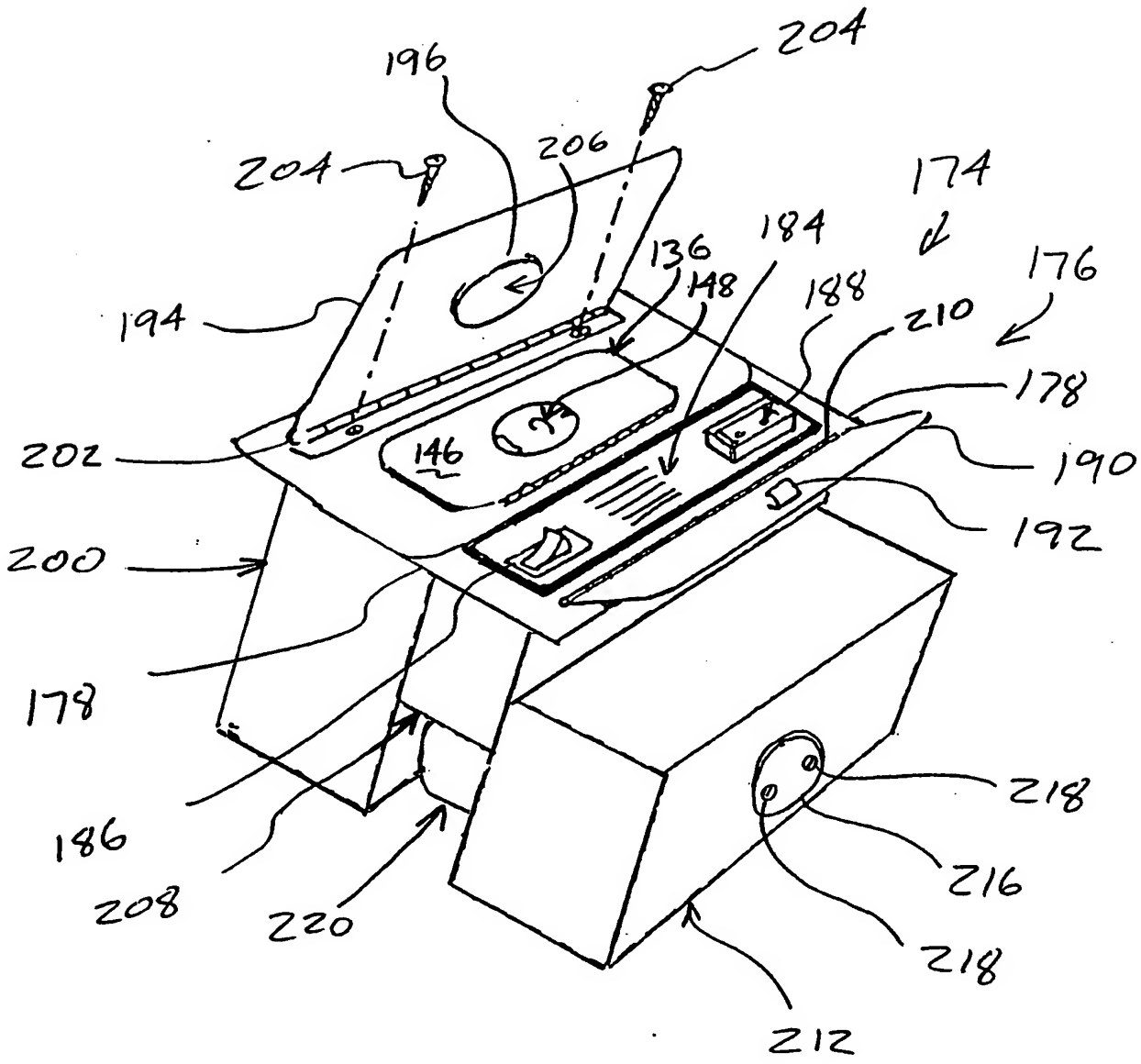
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Fig. 14

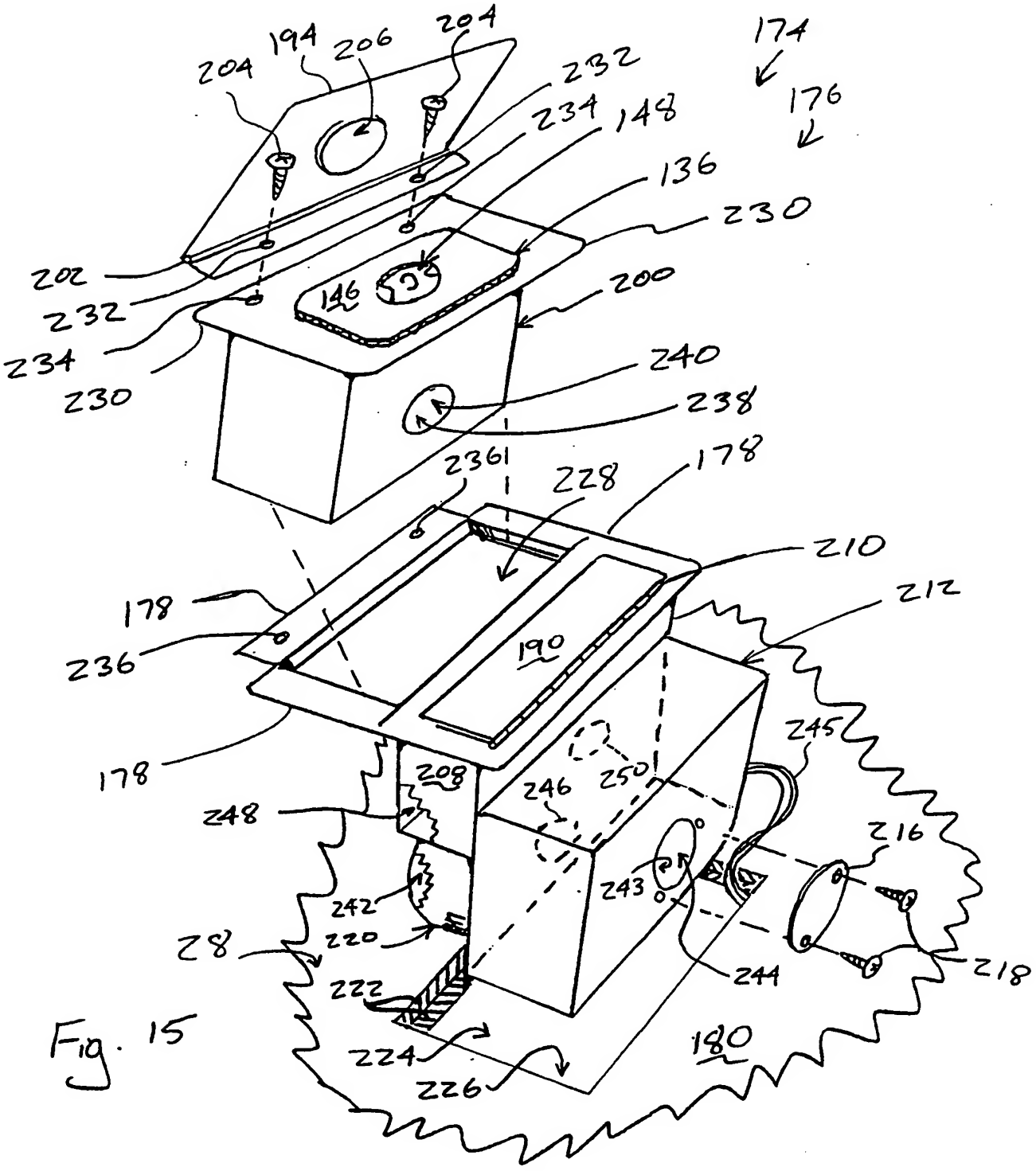
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Fig. 15

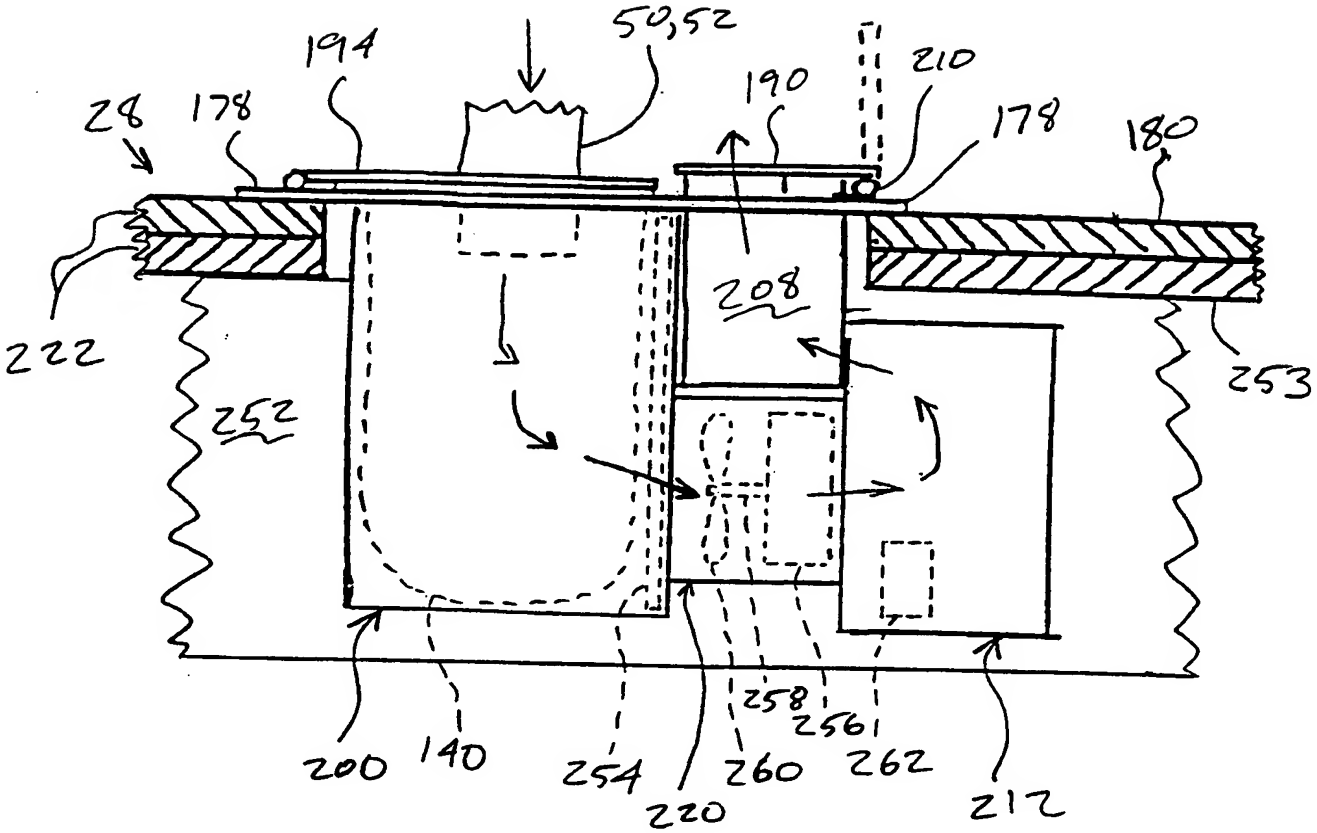
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Fig. 16

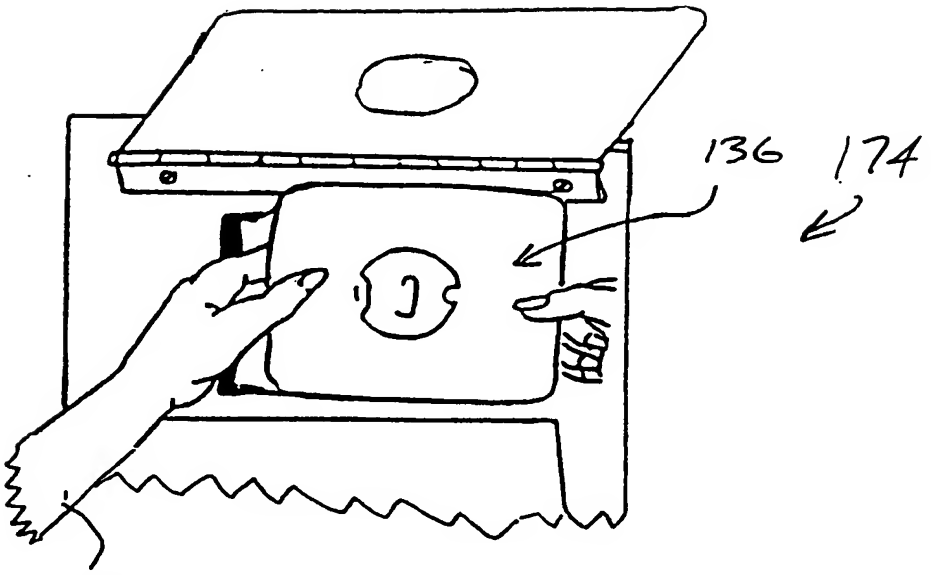

Fig. 17

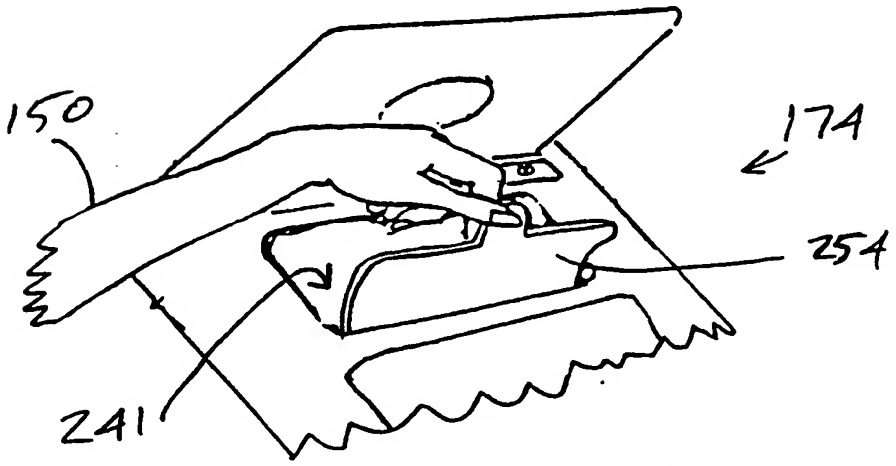

Fig. 18

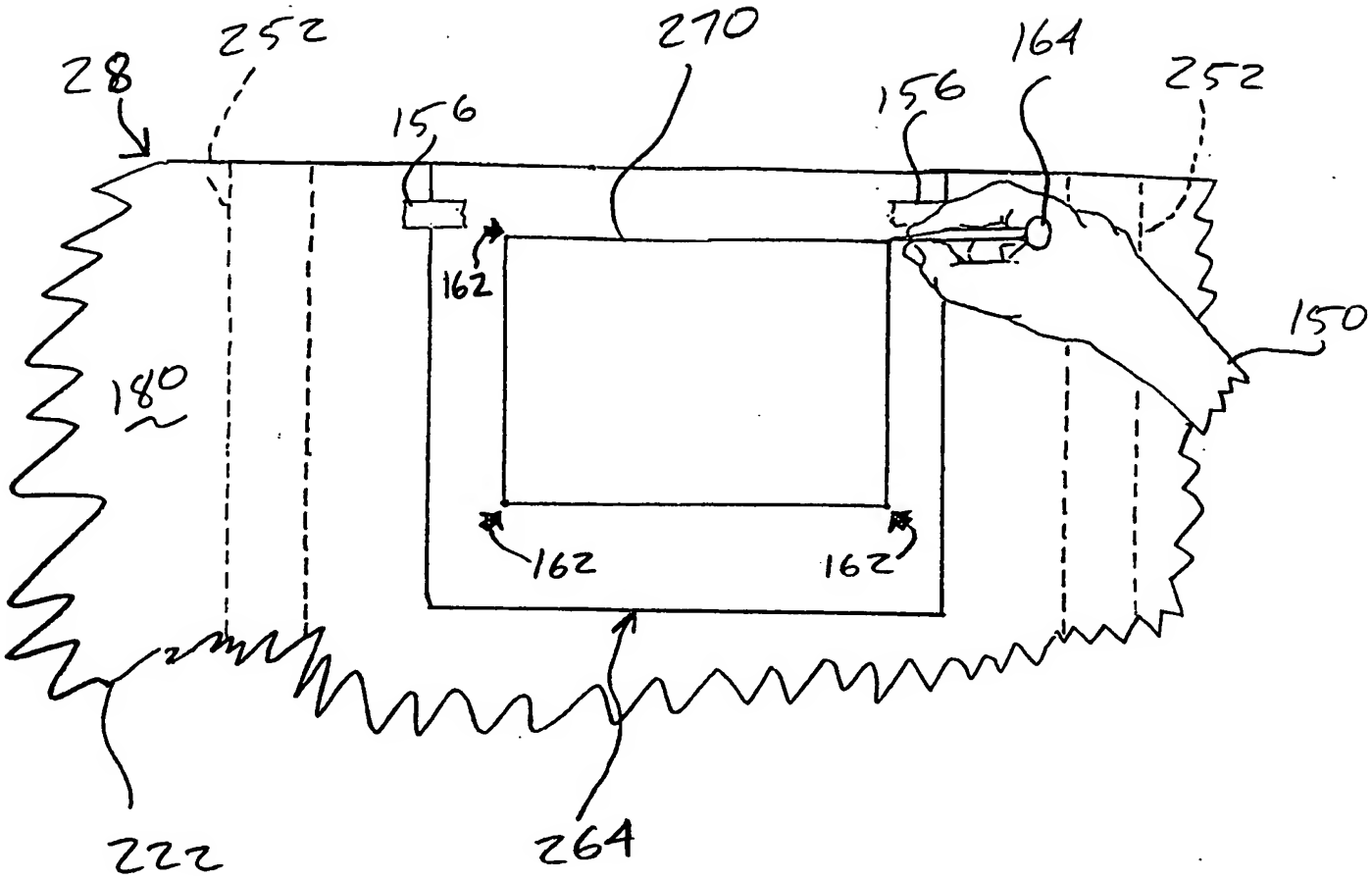

Fig. 19